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# NASA TECH BRIEF

*Lyndon B. Johnson Space Center*



## A Flame-Resistant Modified Polystyrene

**The problem:**

Polystyrenes have many commercial and industrial uses. Consumer products include toys, household wares, appliance cabinets, ice buckets, small boats, and furniture. Industrial applications include insulation, containers and packaging, and machine housings. This versatile material can be formed as sheets, rods, foam, or beads; it is strong, has high impact resistance, and is an excellent insulator. However, it is flammable, and with the increased awareness of safety hazards, both industry and consumers are seeking safe nonflammable materials that have properties as useful as those of polystyrene.

**The solution:**

Several modified polystyrenes have been developed that are self-extinguishing in air. Although their properties are not exactly the same as those of existing polystyrenes, they could serve as nonflammable alternatives to the conventional material for many applications.

**How it's done:**

The modified polystyrene polymers are prepared from monomers of diphenyl-p-styrylphosphine and its derivatives. A number of homopolymers, copolymers, and terpolymers have been prepared and studied. The two most successful polymerization methods are monomer bulk polymerization and substitution of preformed poly (diphenyl-p-styrylphosphine).

Polymer compositions produced by both methods are nontoxic and have superior melting and flame-retardation properties when compared to polystyrene. However, their molding and film-forming capabilities are not generally as good. Of the many systems prepared, the terpolymers have the best overall combination of properties. Furthermore, one monomer derived from a commercially available intermediate (diphenylphosphoryl azide) can be used to form well-adhering films. These films do not have the desired melting characteristic, but this problem might possibly be overcome by careful selection of the monomer ratios in a terpolymer system.

During the development of these compounds, the syntheses of the monomers and the intermediates were studied in detail. This information is included in a published report that also describes the molding and fabrication properties, the toxicology, and the thermal behavior of the polymers. Included are the results of differential scanning calorimetry and thermographic analysis studies of many of the monomers and polymers.

**Notes:**

1: The syntheses and properties of the polymers discussed in this Tech Brief are described in detail in the report:
Flame Resistant Nontoxic Polymer Development
NASA CR-141932 (N75-28230)

A copy of this report may be obtained at cost from:
Technology Application Center
University of New Mexico
Albuquerque, New Mexico 87131
Telephone: 505-277-3622
Reference: B75-10320

2. Specific technical questions may be directed to:
Technology Utilization Officer
Johnson Space Center
Houston, Texas 77058
Reference: B75-10320

(continued overleaf)

**Patent status:**

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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